



A*STAR TALENT SEARCH AND SINGAPORE SCIENCE & ENGINEERING FAIR 2020



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Chairperson, Singapore Science &
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Chairperson, A*STAR Talent Search
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SINGAPORE SCIENCE & ENGINEERING FAIR

BACKGROUND

The Singapore Science & Engineering Fair (SSEF) is a national competition organised by the Ministry of Education (MOE), the Agency for Science, Technology & Research (A*STAR) and Science Centre Singapore. The SSEF is affiliated to the highly prestigious Regeneron International Science and Engineering Fair (Regeneron ISEF), which is regarded as the Olympics of science competitions.

SSEF is open to all secondary and pre-university students between 15 and 20 years of age. Participants submit research projects on science and engineering.

Participants exhibit their projects at the fair where they will be interviewed by judges from local universities, polytechnics and research institutes.

SSEF 2020

592 projects were registered online for the SSEF this year. Of these, 320 were shortlisted for judging in March 2020. The total number of awards for the Main Category was 117, comprising 27 Gold, 22 Silver, 33 Bronze and 35 Merit awards. Additionally, 47 projects were also awarded Special Awards sponsored by six different organisations (Institution of Chemical Engineers Singapore, Singapore University of Technology and Design, Singapore Society for Microbiology and Biotechnology, Yale-NUS College, The Electrochemical Society, and Singapore Association for the Advancement of Science).

In the Junior Scientists Category (for students under 15 years of age), 49 projects were shortlisted at the SSEF this year. 2 Projects were awarded the Commendation award and 4 projects were awarded the Merit award for the Junior Scientists Project Category, while 2 projects were awarded the Commendation award and 5 projects were awarded the Merit award for the Junior Scientists Video Category.

Students did not participate in the Regeneron International Science and Engineering Fair (Regeneron ISEF) 2020 due to the unprecedented situation of COVID 19.

Supported by



FOREWORD



Mdm Lee Lin Yee

Chairperson
Singapore Science & Engineering Fair
Working Committee 2020
Director, Sciences Branch, Curriculum
Planning and Development Division 1,
Ministry of Education

This year, we organised the 20th Singapore Science and Engineering Fair (SSEF) amidst the unprecedented COVID-19 situation. In spite of the difficult circumstances, the SSEF organising committee held on to the belief that the celebration of our students' learning in Science remains key even in the face of the pandemic.

For the first time in SSEF history, the on-site judging for the final round of the fair was held online. Our students displayed admirable resilience and flexibility, adapting to the adjustments that the organising committee worked on tirelessly behind the scenes, just so that our students can have the opportunity to engage in Science, Technology, Engineering and Mathematics (STEM) learning. In the face of adversity, our students continued the good work of their seniors, impressing the judges with the high quality of their projects and the depth of scientific knowledge despite the challenging circumstances. Over 1,000 students from 34 schools submitted a total of 592 research projects for the fair this year, of which a total of 117 projects received Gold, Silver, Bronze and Merit awards. Well done to all!

A good STEM education is critical for the personal development of students to enable them to understand a world confronted with many global

challenges, including public health, biodiversity, sustainability and climate change issues. It also empowers them to be innovative thinkers who can come up with scientific and technological innovations to address these challenges. To this end, SSEF serves as an important platform for students to exercise their creativity, deepen their STEM learning and showcase their STEM research efforts.

A strong ecosystem that nourishes students' development in STEM is fundamental to Singapore's progress in STEM education. Similarly, SSEF is only made possible with the passion and longstanding support from various members of the STEM community. A big thank you to teachers, mentors and partners from research institutes and Institutes of Higher Learning for the valuable time, resources and expertise in guiding our students to achieve their potential in STEM. My deepest appreciation also goes to the organising committee for weathering the storm and pulling SSEF 2020 off. I would like to express my gratitude to our sponsor organisations for giving out the SSEF 2020 Special Awards to recognise our students' contributions. The six organisations are Institution of Chemical Engineers Singapore (IChemE), Singapore Association for the Advancement of Science (SAAS), Singapore Society for Microbiology and Biotechnology (SSMB), Singapore University of Technology and Design (SUTD), The Electrochemical Society (Singapore Chapter), and Yale-NUS College.

Finally, I thank our longstanding partner organisations, A*STAR and Science Centre Singapore, for being strong stewards of the SSEF and for championing STEM education in Singapore.

Thank you.

Mdm Lee Lin Yee

Chairperson
Singapore Science & Engineering Fair Working Committee 2020
Director, Sciences Branch, Curriculum Planning and Development Division 1,
Ministry of Education

SSEF 2020 WINNERS

GOLD

Lin Shuowang

DUNMAN HIGH SCHOOL

Removal of Emerging Organic Contaminant by Low-cost Adsorbent

Emmanuella Li, Michelle Yaochai Yinfei, Ng Minyu Joanna

EUNOIA JUNIOR COLLEGE, NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE, RAFFLES INSTITUTION

Computational study of temperature dependent protein glass transition under varying solvent compositions

Neo Shao Jun, Koh Meng Jin Keith, Low Wei Sheng

HWA CHONG INSTITUTION

Synthesis of Photocatalytic Iron(III) Fumarate Metal Organic Framework Microrods for the Degradation of Organic Dyes

Wang Qin, Zhang Yuge

HWA CHONG INSTITUTION

Investigating different stress-relieving methods using Electroencephalogram(EEG)

Kiefer Ong Xian Yao, Pierre Yeap Yu Song,

Brandon Ong Yen Chow

HWA CHONG INSTITUTION

Synthesis of Magnetic Carbonised Banana Peel as a Versatile and Reusable Adsorbent for Water Purification

Johnny Xiao Hong Yu, Xiang Yang

HWA CHONG INSTITUTION

Electro-Fenton Treatment of the Polyfluorinated Pollutant GenX using Graphene Coated Nickel-Foam Cathode and Boron-doped Diamond Anode

GOLD

Huang Qirui, Chua Rui Hong, Ng See Jay

HWA CHONG INSTITUTION

Connect Singapore

He Donghang, Liu Juncheng, Loh Chi Wen

HWA CHONG INSTITUTION

The polygon, The spiral and The mice

Wang Junyao Floria

HWA CHONG INSTITUTION

Transport and Optical Studies of Two Dimensional Electron Gas (2DEG) in AlN/SrTiO₃ heterostructure

Ethan John Lim, Qi Tianshi, Fu Wenbo

HWA CHONG INSTITUTION

Hydrogen Functionalization of Graphene using RF Plasma for Photodetection

Zhou Chengyang, Dinh Thao Vy, Kong Heyi

HWA CHONG INSTITUTION

Automated deep learning analysis of angiography video sequences for coronary artery disease

Nuur Hasanah Bte Noor Azman

MILLENNIA INSTITUTE

Blue on blue: blue fluorescing aluminium molybdate for methylene blue sensing

Chen Runjia

NATIONAL JUNIOR COLLEGE

Novel Function-Conferring Effector Domains in CRISPR-Cas13 System for Improved Specificity in RNA Editing

GOLD

Ho Su Minn Jeilene

NATIONAL JUNIOR COLLEGE

Polymer ions conductors for multifunctional structural energy storage devices

Esther Ong Lee Ann, Yu Jing Siong

NATIONAL JUNIOR COLLEGE

Silica Nanoparticles for Oil Extraction

Ho Xin Yi, Ariel, Sun Ruitong, Yue Sichen

NATIONAL JUNIOR COLLEGE

Polyelectrolyte Microcapsules Investigated by Magnetic Nanoparticles

Qiu Xinzhi, Yam Hong Meng, Wu Ning Jing

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

DNA Proximity Circuit - A Universal Platform for Analyzing Biomarkers

Poon Cheng Jun, Tay Qi Ying, Sasha Chew Xuan Rong

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Cardioscopic Evaluation and Quantitative Estimation of Mitral Apparatus in Quasi-Dynamic State in Ex-Vivo Swine Model

Le Ngoc Mai, Marvell Ung Wew, Varsha Ramkumar

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Automating the Plackett-Burman design as a screen to analyse the interactions of different germinants in the the germination of C. Novyi spores

Loh Pei Yi, Sean Leong Kar Weng, Zhang Chi

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Graphene and Montmorillonite-Enabled Ultrastretchable Integrated Chemical Barriers and Fire Retardant Nanocoatings for Next-Generation Protective Clothing

Lu Bolin, Wang Ruihai, Xu Shuwei

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Quality analysis of 2D materials with computer vision

GOLD

Wong Swee Chong, Dave

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Gait Recognition for Person Tracking Across Camera Network

Loi Zi Xian, Pang Hsien Teng Elody

RAFFLES GIRLS' SCHOOL (SECONDARY)

Biodegradation of Bisphenol A (BPA) by Chlorella fusca

Selina Peh Yuet Ning

RAFFLES GIRLS' SCHOOL (SECONDARY)

Changing Eigenfrequencies and Sound Characteristics of Resonant Cavities Filling Up With Water

Cylin Sim Kiat

RAFFLES INSTITUTION

Bimetallic Phosphide Nanoparticles as Efficient Sulfur Hosts for Lithium-Sulfur Batteries

Zhang Xianghao Jeffrey

RAFFLES INSTITUTION

Novel Nanocomposites for Solid State Electrolytes

Jonathan Chew Jian Pin, Chua Yong Liang,

Chan Yin Leng Ysabel

RIVER VALLEY HIGH SCHOOL

Conversion of Rainwater to Electricity in Singapore's High Rise Buildings

SILVER

Tan Yung Zhen, Justin Neo Boon Shuan, Ong Chee How

ANDERSON SERANGOON JUNIOR COLLEGE

Artistic Transformation of In2O3 Nanowires via Focused Laser Painting

Tan Li Wen, Steffi, Hu Yuzhou

DUNMAN HIGH SCHOOL

Beauty in the Eye of the Bee-holder: Novel Laser-induced Fluorescence in Orchid

Bryan Yeo Bin Yuan, Tan Xin Hui, Derek Tang Haowen

HWA CHONG INSTITUTION

Genetic modifiers of alpha synuclein in a Parkinson's disease model

Lim Dillion, Ho Shanley, Bryan Lee Chong Han

HWA CHONG INSTITUTION

Facile and One-Step Synthesis of Zirconium Oxide Nanoparticles for Removal of Phosphate and Lead(II) Ions

Low Jeen Liang, Yiu Yi Hin Kinsey, Tan Wei An

HWA CHONG INSTITUTION

Adsorption and Enhanced Electrochemical Adsorption for the Treatment of Pharmaceutical Wastewater

Clarissa Joanna Lim, Erica Tan Si Jie

HWA CHONG INSTITUTION

Synthesis of Hydrophobic Coatings for Building Applications

Christopher Ong Xianbo, Quek Jia Zhi, Shaun, Benson Lin Zhan Li

HWA CHONG INSTITUTION

Customisable carplate recognition system for security enhancement

Zheng Yilin

HWA CHONG INSTITUTION

Study of radiation effects in cells using fluorescence microscopy and computational image processing techniques

SILVER

Dhivya Ramnarayan

NATIONAL JUNIOR COLLEGE

Characterisation of a fully synthetic heparan sulphate decamer for enhancing BMP-2 stability and bioactivity

Zhang Jun Lu, Victoria Ong Dai Qi, Sean Lee Chuan Zhou

NATIONAL JUNIOR COLLEGE

The Effects of Vermicomposted Soybean Waste (okara) as Biostimulants on the Quality of Growth of Brassica Rapa Var. Parachinensis (choy sum)

Hu Xun

NATIONAL JUNIOR COLLEGE

Atomic layer deposited, mixed ceramic-photopolymer composites for solid-state electrolytes

Zhu yuqing

NATIONAL JUNIOR COLLEGE

Facial Recognition System

Zheng Chong Emily, Koh Yi Hui, Prathiksha Karthikeyan

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE,

RAFFLES INSTITUTION, ST. JOSEPH'S INSTITUTION

Examining the Immune Responses to Intrauterine Transplantation of Maternal and Paternal Hematopoietic Stem Cells: a more faithful model

Lucas Tan Shaen En, Srivathsan Ram, Pavan Singh Sheena

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Optical Techniques in Determining Adsorption of Organic Pollutants by Molecular Layers on Hard Substrates from Waters of Different Salinity

Cheng Yi, Yu Sutong

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Osmotic power generation by pressure retarded osmosis (PRO)

Kim Yongbeom, S Vengat, Sim Hui Xiang

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

A Sharp Trigonometric Double Inequality

SILVER

Kerk Tai Heng, Sean Wang, Lu Bolin

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Gamification of Organic Chemistry

Wong Ee Min Sarah, Jiang Chen

RAFFLES GIRLS' SCHOOL (SECONDARY)

Development of an Intelligent System for Monitoring Birds' Health in the new Mandai Bird Park

Janessa Valencia Guo Jiaxuan,

Axel Jude Chong He Jun, Oliver James Tan

RAFFLES GIRLS' SCHOOL (SECONDARY), ST. JOSEPH'S INSTITUTION,
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

HoneySpider : Improving Deception Capabilities of Honeypots by Learning Web Surfing Behaviour

Mendell Yap Haw Chuen, Lim Kai Qi, Chelsea Chan Li Xin

RIVER VALLEY HIGH SCHOOL

Optimising yield of lipids from common Singaporean macroalgae using varying cell disruption methods

Kevin Khoo Weixue

RIVER VALLEY HIGH SCHOOL

Aerosol Jet Printing of Microheaters on Bandage for Localised Heat Treatment

Lim Jia Qing

RIVER VALLEY HIGH SCHOOL

Fake News Detection on Twitter: A Content Based Approach

BRONZE

Henry Lam Wing Ha

ANGLO-CHINESE JUNIOR COLLEGE

Design for Antenna Gain Enhancement using Low Cost Dielectric Lens for applications in 5G technology

Natasya Nurfatihah Binte Ahmad Rahim

CLEMENTI TOWN SECONDARY SCHOOL

Restoring DNA Repair in cells over expressing histone H1

Choo Yan Ying Desiree, Pan Yifan

DUNMAN HIGH SCHOOL, RAFFLES INSTITUTION

Investigation of Flow Resistance and Air-Blast Propagation through Ventilation Pathways

Andy Yeoh Kaijie

DUNMAN HIGH SCHOOL

Two-Dimensional Arrays of Magnetic Nanoparticles

Lee Yu Han, Sin Kai Jun

HWA CHONG INSTITUTION

Identifying Sites of ADAR Activity in RNA Using cDNA Sequencing

Ng Yan Bin Lucas, Lucas Koh Eu Jen, Peng Zi Kang

HWA CHONG INSTITUTION

Fabrication of Microbial Fuel Cells Powered by Organic Waste and Wastewater to Generate Bioelectricity

Grace Gao Wenjun, Shen Miao Yu

HWA CHONG INSTITUTION

Development and Enhancement of a Smart White Cane

Jeremy Ng Ding Jie

HWA CHONG INSTITUTION

Self-Tuning Magnetometer

BRONZE

Tian Shuhao

HWA CHONG INSTITUTION

Study of Heat Equations and Solutions with applications to Finance and Engineering

Koo Jun Yuan, Ryan Teoh, Zong Sheng Hao

HWA CHONG INSTITUTION

Investigating the effects of phytoextracts on protecting Saccharomyces cerevisiae from oxidative stress

Chen Keying

HWA CHONG INSTITUTION

Investigation of Chemical Vapour Deposited Monolayer Graphene on Bacterial and Mammalian Cell Behaviour

Ong Sheng Hao, Ho Shane

HWA CHONG INSTITUTION

Synthesis of Long Silver Nanowires using a Facile One-Pot Polyol Method for Transparent Conductive Films

Leng Wen Hui, Vania Crystal Halim

HWA CHONG INSTITUTION

Development of Augmented Reality Navigation Application

Thangaraja Keerthana

NATIONAL JUNIOR COLLEGE

Genetic regulation of cancer candidate CD123

Mao Huanqing

NATIONAL JUNIOR COLLEGE

Understanding NFkB regulatory networks in monocytes

Lin Mingwan

NATIONAL JUNIOR COLLEGE

Nanopore Sequencing Enables Transcriptome-Wide Profiling of RNA Modifications

BRONZE

Chan Wan Teng, Phoo Thitsar Aung

NATIONAL JUNIOR COLLEGE

Design and Synthesis of S-adenosyl-methionine amine analogues for structural studies of methyltransferases

Ye Haoran, Tan Tag Han

NATIONAL JUNIOR COLLEGE, NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Stapling of Gliadin- α 1 Peptide for the Treatment of Celiac Disease

Kodhai d/o Karnan

NATIONAL JUNIOR COLLEGE

Optical modeling and simulation of nanostructured solar cell for renewable energy

Declan Koh Shaojun

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Methodologies for screening and documentation of micro-molluscs in intertidal and benthic communities around Singapore

Shevonne Chia, Cheng Yi, Nicole Tang

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

MicroRNA-profiling based screening of non-small-cell lung cancer in plasma

Tan Jo Shin, Eishwar Ravichandran

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Soundscape Deep-Learning Driven IOT Model for Smart City Noise Monitoring

Sahel Tan Xunwei, Clara Quek Guo Ting, K.V. Samyukktha

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Isolation and Characterization of Pseudomonas Aeruginosa Phages From The Environment

Tan Cheng Yat, Jason Ong Han Meng

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Screening and Characterisation of Novel Environmental Phages

BRONZE

Gajula Anirudh, Wes Lee Wen Jun

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Achieving Low Resistance Contacts to TMDCs (Transition Metal Dihalogenides)

Matthan Foo Ce Xiang

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Pure and Doped BiFeO₃ Thin Film for Photodetector

Ng Kay Hian, Sean Ng Hao Jun, Siew Xuan Hui

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

EEG based multitasking assessment using simultaneous spatiotemporal stimulus

Zhou Xinyan

RAFFLES GIRLS' SCHOOL (SECONDARY)

Automatic Recovery Systems for Autonomous Underwater Vehicles (AUVs)

Leo Kee Kiat Ethan, Wang Zicheng, Htut Myat Min

RAFFLES INSTITUTION

Nutrient Recovery from Okara after Probiotic Fermentation using Rhizopus oligosporus

Michael Shio Yong Zhi, Lex Tan Pengqin, Ethan Goh Chee Kiat

RAFFLES GIRLS' SCHOOL

Copper Carbene complexes for photoredox catalytic chemistry

S.Sandiyashini, Krithika Udayasankar,

Anushuya Gopalakrishnan

RAFFLES INSTITUTION

Biomimetic zeolite for the removal of metal ions and methylene blue dye from wastewater

Long Yu, Jolene Oh Ruixi, Faith Tan Li Min

TEMASEK JUNIOR COLLEGE

Investigating the Changes in Electroencephalogram (EEG) when Listening to Competing Speakers

BRONZE

Lyu Lanqing

VICTORIA JUNIOR COLLEGE

Circuit Modelling of Spintronic Devices

MERIT

Lim Rui Yi Ray

DUNMAN HIGH SCHOOL

Quantitative Measurements in Piezo-Actuated Vibrating Sample Magnetometry

Liao Haotian

HWA CHONG INSTITUTION

Functional Characterization of a novel mutant of Colony Stimulating Factor 1 Receptor (CSF1R) in patient with Hereditary Diffuse Leukoencephalopathy with spheroids (HDLS)

Hu Yang

HWA CHONG INSTITUTION

Automated sorting of neuronal action potentials from in vivo extra-cellular electrophysiological recordings

Yan Jun Jie, Merwin Tham Weng Yahn, Yap Ray Kai Joel

HWA CHONG INSTITUTION

Fabrication of Hydrophobic Cellulose Aerogel from Pineapple Waste for Oil Spill Clean Up

Li Shi Tan, Li Fangxiao

HWA CHONG INSTITUTION

Functionalised soft robots using smart fabric components

Ng Wee Lok, Bryan, Toh Yi Zhong

HWA CHONG INSTITUTION

Development of an Autonomous Mail and Package Delivery Vehicle

MERIT

Tey Yi Fan, Chow Guan Ze, Axel Tong Cheng Yong

HWA CHONG INSTITUTION

Bottle Pitches

JUSTIN NG TENG LOONG, Lu Jin Wei Ethan, Sim Jing Heng

HWA CHONG INSTITUTION

Investigating the antibacterial and antioxidant properties of slime track and plasmoidal extracts from slime mold

Tan Wei Liang Darrius, Lim Chern Howe Ryan, Tay Hock Jun

HWA CHONG INSTITUTION

Investigating the use of phosphate removing organisms in bioremediation

Yoong Hong Jun, Nicholas, Lee Kern

HWA CHONG INSTITUTION

Investigating the Printability of Materials on a Novel Handheld 3D Printing Pen

Loh Qian Ying, Shreya Reddy, Tessa Tan Ying Zhen

JURONG PIONEER JUNIOR COLLEGE, VICTORIA JUNIOR COLLEGE,
VICTORIA JUNIOR COLLEGE

The Glycan Landscape of Human Cells

Ellia Tio Shu Yi, Yeo Jia Ying

METHODIST GIRLS' SCHOOL (SECONDARY),

RAFFLES GIRLS' SCHOOL (SECONDARY)

Compact Spidron Antenna for UWB Applications

Soh Ze Kai, Loke Mei Qi Jessica

NANYANG JUNIOR COLLEGE, RIVER VALLEY HIGH SCHOOL

Investigating the dynamics of commuter overcrowding during train disruptions

Xie Wanxin, Cheah Yi Kang, Xavier

NATIONAL JUNIOR COLLEGE

Evaluation tools for distributed small scaled plastic recycling systems

MERIT

Li Yifan, Shen Lingbo, Tan Jing Yi

NATIONAL JUNIOR COLLEGE

Validating the effect of temperature on the integrity of Layered Double Hydroxide

Luo Jiale, Zhang Wenqing, Chen Wenxin

NATIONAL JUNIOR COLLEGE

Mixed Reality Simulations

Poh Chieng Ling

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Computational Studies of Cell Durotaxis on Extracellular Matrix Rigidity Gradients as a Model for Wound Healing and Fibrosis

Qin Haichen, Joshua Chin Zhi Yi, Tang Shun

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Creative Solution to Overcome Detuning due to Liquid and Metal for UHF RFID

Deepankur John Njondimackal, Tan Yueh Yang Vince

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Empirical Evaluation of Perimetry and Electrophysiology methods in visual field assessment

Kuai En Kai, Ethan, Krithikh Gopalakrishnan, Tan Jun Wei

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Improving Simple and Efficient Minwise Hashing with Extra Information

Jonathan Tan Soon Kang, Wu Yekai

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Effects of Tumour Microenvironment on MHC Class 1 and PD-L1 Receptors on Hepatocarcinoma Cells: Relevance to Immunotherapy

Tang Yun, Marie Ng Min Rui, Magdalene Lim Yong Qi

RAFFLES GIRLS' SCHOOL (SECONDARY)

Mitigating the Threat of BPA to Animals using Vegetables

MERIT

Lucia Li, Charlotte Chua Jia Xuan, Chloe Lim Xuan

RAFFLES GIRLS' SCHOOL (SECONDARY)

Biopurification using Plant Xylems

Lim Jun De, Jayden Kim Jun-Sheng

RAFFLES INSTITUTION

Evaluating the effect of HDAC7 inhibition in glioblastoma

Windle Charles Jordi, Lai Haoxing, Loh Zhi Yuan, Melvin

RAFFLES INSTITUTION

Development of Zinc Sensor Based on Molecularly Imprinted Polymers

Li Fangqing, Kiera Lau Yan Yu, Gladys Chong Wan Yi

RAFFLES INSTITUTION

Heavy Metal Ion Adsorption using Biochar from Mango Endocarp and Mango Seed Kernel

Jerald Siah Chi Ming, Samuel Foo Enze

RAFFLES INSTITUTION

Directional Anemometry using Magnetic Microwires

Matthew Yar Kwok Jway

RAFFLES INSTITUTION

An acoustic study on the dispersive flexural modes of wave propagation in a helical spring

Ma Fanghe

RAFFLES INSTITUTION

Natural Language Processing in fake news detection

Xavier Lien Tong Wei, Pakhale Advay Dilip

RAFFLES INSTITUTION

AI for Semi-Automatic Grading of Online Formative Assessments

Divye Baid, Shen Xin Yi, Zhang Yu Chi

RAFFLES INSTITUTION

An Analysis on the Efficiencies of Quantum Algorithms

MERIT

Niu Jingwen, Goh Yee Xin, Justin Chew Yaojie

RIVER VALLEY HIGH SCHOOL

Effect of different types and concentrations of various substrate-biomolecules on the voltage of electricity generation in Microbial Fuel Cell (MFC) using Escherichia Coli

Ng Simin

RIVER VALLEY HIGH SCHOOL

Design and Development of 3D Printed Functionally Graded Structures for Broadband Sound Absorption

Wang Yike

VICTORIA JUNIOR COLLEGE

Wireless signal coverage modeling and optimization in visible light communication

Yeo Jaye Lin

VICTORIA JUNIOR COLLEGE

Enhancing Single-photon Emission Dynamics of Nitrogen-Vacancy Centres

JUNIOR SCIENTIST AWARD

Tan Jie Xin, Chia Yi Xuan, Naomi, Ng Shi Ting, Kay

METHODIST GIRLS' SCHOOL (SECONDARY)

In-vitro Propagation of Bulbophyllum fascinator

Tan Jia Hao, Aasher Lim Yan Kai

NATIONAL JUNIOR COLLEGE

Investigation of Surface Treatment on Biofabricate Leather made from Kombucha

Joshua Siew Yong En, Gabriel Keith Lui, Ter Sheng Kai

HWA CHONG INSTITUTION

Investigating the anti-bacterial, anti-fungal and immunostimulating properties of Lumbricus Terrestris

JUNIOR SCIENTIST AWARD

**Mahendran S/O Ravindran, Kuan Ming Jie,
Ethan Lim Heng Rwei**

HWA CHONG INSTITUTION

Investigating the anti-bacterial, anti-oxidant and wound healings effects of Areca catechu

Yu Hanzhang

RAFFLES GIRLS' SCHOOL (SECONDARY)

Assignment of Competition Teams to Judges

Jamie Lim Jia Sin

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Finding Colourful Trails

JUNIOR SCIENTIST VIDEO CONTEST

Alicia Jocelyn Tjokro, Lim Kia Iag, Debraath Pahari

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

The efficiency of using biowaste as a greener alternative to conventional fuel

Lim Jun Teck, Bryan, Kuok Ray Ann, Chew Kuan Yu Ervin

CLEMENTI TOWN SECONDARY SCHOOL

How yeast cells repair DNA double strand breaks

Tan Jie Xin, Chia Yi Xuan, Naomi, Ng Shi Ting, Kay

METHODIST GIRLS' SCHOOL (SECONDARY)

In-vitro Propagation of Bulbophyllum fascinator

Saravanan Manobharathi, Senthilvel Kunashree, Johnson Angelin

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Investigation on type of biomass that yields the most bioethanol

Irudayaraj Livana, Pasumarthy Srihitha, Sarika

CRESCENT GIRLS' SCHOOL

Investigation of the effectiveness of household products in cleaning crayon stains

**Huang Li Yang James, Chan Chee Yong Leemen,
Karthikeyan Sujatha Aadithya**

NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE

Effect of Saturation in Saponified Carboxylic Acid Chains on their Effectiveness as Soap

**Chia Yu Heng Alvin, Nabiilah Rifqah Hasanah Mauliyadi,
Rajendran Adhithya**

JURONG SECONDARY SCHOOL

Investigation on the Effectiveness of Human Hair in Adsorbing Gutter Oil

SSEF SPECIAL AWARDS BY INSTITUTION OF CHEMICAL ENGINEERS (IChemE)

Jiang Bohan, Li Hui

NATIONAL JUNIOR COLLEGE

Investigation into the usage of Desalination Fuel Cells in purifying water contaminated with Heavy Metal Compounds

Cylvn Sim Kiat

RAFFLES INSTITUTION

Bimetallic Phosphide Nanoparticles as Efficient Sulfur Hosts for Lithium-Sulfur Batteries

Niu Jingwen, Goh Yee Xin, Justin Chew Yaojie

RIVER VALLEY HIGH SCHOOL

Effect of different types and concentrations of various substrate-biomolecules on the voltage of electricity generation in Microbial Fuel Cell (MFC) using Escherichia Coli

SSEF SPECIAL AWARDS BY SINGAPORE ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (SAAS)

Henry Lam Wing Ha

ANGLO-CHINESE JUNIOR COLLEGE

Design for Antenna Gain Enhancement using Low Cost Dielectric Lens for applications in 5G technology

Charlene Kok Hui Ping

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Development of small-molecule inhibitors of a protein-protein interaction by in silico fragment screening for development of cancer therapeutics

Natasya Nurfatihah Binte Ahmad Rahim

CLEMENTI TOWN SECONDARY SCHOOL

Restoring DNA Repair in cells over expressing histone H1

Wee Zhuo Lin, Huang Shi Rui, Darius Lim Xiang Wen

DUNMAN HIGH SCHOOL

Optimisation of bigel system to maximize delivery of plant derived anti inflammatory compounds

Ezeck Chong, Yeo Rong Quan

HWA CHONG INSTITUTION

Investigating the Effect of Quinine-Induced Autophagy Inhibition on the Efficacy of Curcumin Cancer Treatment

Yan Jun Jie, Merwin Tham Weng Yahn, Yap Ray Kai Joel

HWA CHONG INSTITUTION

Fabrication of Hydrophobic Cellulose Aerogel from Pineapple Waste for Oil Spill Clean Up

Ong Jing Xuan

HWA CHONG INSTITUTION

Design and development of an innovative distributed vertical lift-transition Unmanned Aerial Vehicle

SSEF SPECIAL AWARDS BY SINGAPORE ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (SAAS)

Lu Yiting

HWA CHONG INSTITUTION

Visual and Augmented Reality Technology Enhanced Animal Animation

Christopher Ong Xianbo, Quek Jia Zhi,

Shaun, Benson Lin Zhan Li

HWA CHONG INSTITUTION

Customisable carplate recognition system for security enhancement

Ariel Wee Shi Shuen

METHODIST GIRLS' SCHOOL (SECONDARY)

Design and development of an innovative distributed vertical lift-transition Unmanned Aerial Vehicle

Esther Ong Lee Ann, Yu Jing Siong

NATIONAL JUNIOR COLLEGE

Silica Nanoparticles for Oil Extraction

Xie Wanxin, Cheah Yi Kang, Xavier

NATIONAL JUNIOR COLLEGE

Evaluation tools for distributed small scaled plastic recycling systems

HO XIN YI, ARIEL, SUN RUITONG, YUE SICHEN

NATIONAL JUNIOR COLLEGE

Polyelectrolyte Microcapsules Investigated by Magnetic Nanoparticles

Allysa Tan Li Ying, Chen Keqin

NATIONAL JUNIOR COLLEGE

Microsphere Optical Nanoscope

MOHAMED NAVAS FARHAN, JOSHUA RAYMOND NG

NUS HIGH SCHOOL OF MATHEMATICS & SCIENCE

Generation of aligned structures from decellularized plants for 3D tissue culture

SSEF SPECIAL AWARDS BY SINGAPORE ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE (SAAS)

**Paul Seow Jian Hao, Alexander Goo Zong Han,
Leticia Tok Jia Ying**

NUS HIGH SCHOOL OF MATHEMATICS & SCIENCE

List colouring of complete bipartite graphs applications in 5G technology

Sahel Tan Xunwei, Clara Quek Guo Ting, K.V. Samyukktha

NUS HIGH SCHOOL OF MATHEMATICS & SCIENCE

Isolation and Characterization of Pseudomonas Aeruginosa Phages From The Environment

From The Environment

Jonathan Tan Soon Kang, Wu Yekai

NUS HIGH SCHOOL OF MATHEMATICS & SCIENCE

Effects of Tumour Microenvironment on MHC Class 1 and PD-L1 Receptors on Hepatocarcinoma Cells: Relevance to Immunotherapy

Zhang Qianyu, Lew Zhiyi, Lim Sze Min, Joan

RAFFLES INSTITUTION

Coral Feeding

Jayabaskaran Jayanth

RAFFLES INSTITUTION

Isolation and characterization of secondary metabolites of Morinda citrifolia and investigation of their Tissue Culture, Antidiabetic, Antioxidant and Antimicrobial potential

Jonathan Chew Jian Pin, Chua Yong Liang,

Chan Yin Leng Ysabel

RIVER VALLEY HIGH SCHOOL

Conversion of Rainwater to Electricity in Singapore's High Rise Buildings

SSEF SPECIAL AWARDS BY SINGAPORE SOCIETY FOR MICROBIOLOGY & BIOTECHNOLOGY (SSMB)

Sahel Tan Xunwei, Clara Quek Guo Ting, K.V. Samyukktha

NUS HIGH SCHOOL OF MATHEMATICS & SCIENCE

Isolation and Characterization of Pseudomonas Aeruginosa Phages From The Environment

SSEF SPECIAL AWARDS BY SINGAPORE UNIVERSITY OF TECHNOLOGY AND DESIGN (SUTD)

Ng Juin Ron, Chin Le Xuan, Caylee, Sng Qihan

DUNMAN HIGH SCHOOL

Mechanical and Water Barrier Properties of Protein Films Modified with Clay Nanocomposites

Sherman Chann Zhi Shen

HWA CHONG INSTITUTION

Machine Learning Approach to Privacy Preservation

Leng Wen Hui, Vania Crystal Halim

HWA CHONG INSTITUTION

Development of Augmented Reality Navigation Application

Zhou Chengyang, Dinh Thao Vy, Kong Heyi

HWA CHONG INSTITUTION

Automated deep learning analysis of angiography video sequences for coronary artery disease

Sun Xinyu

NATIONAL JUNIOR COLLEGE

Machine Learning Approach to Privacy Preservation

SSEF SPECIAL AWARDS

BY SINGAPORE UNIVERSITY OF TECHNOLOGY
AND DESIGN (SUTD)

Li Fangqing, Kiera Lau Yan Yu, Gladys Chong Wan Yi

RAFFLES INSTITUTION

Heavy Metal Ion Adsorption using Biochar from Mango Endocarp and Mango Seed Kernel

Hemadri Rajam Ramkumar, Tay Wan Ni, Nicole

RAFFLES INSTITUTION

3D Printed Prosthetic Hand

Ma Fanghe

RAFFLES INSTITUTION

Natural Language Processing in fake news detection

Chen Haoyang , Dawn Lok

RAFFLES INSTITUTION

Investigating the feasibility of using 3D Printing in the design and production of Orthopedic Casts

Ng Simin

RIVER VALLEY HIGH SCHOOL

Design and Development of 3D Printed Functionally Graded Structures for Broadband Sound Absorption

Jonathan Chew Jian Pin, Chua Yong Liang,

Chan Yin Leng, Ysabel

RIVER VALLEY HIGH SCHOOL

Conversion of Rainwater to Electricity in Singapore's High Rise Buildings

SSEF SPECIAL AWARDS

BY THE ELECTROCHEMICAL SOCIETY,
SINGAPORE CHAPTER (ECS)

Cylin Sim Kiat

RAFFLES INSTITUTION

Bimetallic Phosphide Nanoparticles as Efficient Sulfur Hosts for Lithium-Sulfur Batteries

Leong Hui Min, Chescia Lim Yi-Xin, Amanda Drea Chandra

NATIONAL JUNIOR COLLEGE

Exploring the use of Organic, Cost-Efficient Membranes to boost MFC's energy efficiency

Niu Jingwen, Goh Yee Xin, Justin Chew Yaojie

RIVER VALLEY HIGH SCHOOL

Effect of different types and concentrations of various substrate-biomolecules on the voltage of electricity generation in Microbial Fuel Cell (MFC) using Escherichia Coli

SSEF SPECIAL AWARDS BY YALE-NUS

Huang Qirui, Chua Rui Hong, Ng See Jay
HWA CHONG INSTITUTION
Connect Singapore

He Donghang, Liu Juncheng, Loh Chi Wen
HWA CHONG INSTITUTION
The polygon, The spiral and The mice

Koh Yu Ching Evelyn, Harsh Thakur, Jiang Peizhi
NATIONAL JUNIOR COLLEGE
Music generation via 1-D cellular automata

Tang Yun, Marie Ng Min Rui, Magdalene Lim Yong Qi
RAFFLES GIRLS' SCHOOL
Mitigating the Threat of BPA to Animals using Vegetables

Lucia Li, Charlotte Chua Jia Xuan, Chloe Lim Xuan
RAFFLES GIRLS' SCHOOL
Biopurification using Plant Xylems

Selina Peh Yuet Ning
RAFFLES GIRLS' SCHOOL
Changing Eigenfrequencies and Sound Characteristics of Resonant Cavities Filling Up With Water

Mendell Yap Haw Chuen, Lim Kai Qi, Chelsea Chan Li Xin
RIVER VALLEY HIGH SCHOOL
Optimising yield of lipids from common Singaporean macroalgae using varying cell disruption methods

SSEF SPECIAL AWARDS BY YALE-NUS

**Tng Yan Ning Jamie, Tay Kai Xuan Charlene,
Lim Jia Han, Jarred**
RIVER VALLEY HIGH SCHOOL
Investigating the potential of antibacterial probiotic gels for improved wound healing

Rowena Kwan Lee Ying, Ho Qingyi Dorothea, Tee Jia Yu
RIVER VALLEY HIGH SCHOOL
Synthesis of UV-Protective Biodegradable Plastic from Chicken Eggshells

Tang Yu Han Brandon
TEMASEK JUNIOR COLLEGE
Helping the Visually Impaired Navigate at Bus Stops

A*STAR TALENT SEARCH

BACKGROUND

The A*STAR Talent Search (ATS) is an initiative by the Agency for Science, Technology and Research (A*STAR) launched in 2006 to reward students who have performed well in scientific research. It is part of the A*STAR Graduate Academy (A*GA)'s Youth Science outreach to schools with the aim to inculcate and develop a passion in science in the young in Singapore. The ATS is organised with the support of the Science Centre Singapore. The ATS is an annual competition which acknowledges and rewards students aged 15 to 20 years old who have a strong aptitude for science & technology. This competition provides students the opportunity to showcase their stellar projects and encourage them to further experiment with science and technology.

Candidates are required to showcase their research projects in the Singapore Science & Engineering Fair (SSEF) for the first round of judging. Short-listed candidates will then undergo at least two more rounds of selection before the winners are chosen. The panel of judges consists of distinguished scientists from local and international universities, as well as A*STAR research institutes. ATS winners need to display resourcefulness, mastery of scientific concepts, as well as passion for scientific research.

ATS 2020

Over 500 SSEF participants had registered online to take part in ATS, but only 63 participants qualified for the shortlisting round after the SSEF results were announced.

The shortlisting round was conducted on 17 August 2020 and 7 finalists were selected for the final judging on 1 September 2020. The winners of the 2020 ATS were officially announced via emails and on Science Centre website.

Student Awards

First Place:	Second Place:	Third Place:
Qiu Xinzhi	Jonathan Chew Jian Pin	Tian Shuhao

Commendation:

Ethan John Lim, Michelle Yaochai Yinfei,
Sarah Wong Ee Min, Thangaraja Keerthana

School Awards

First Place:	Joint Second Place:
NUS High School of Mathematics and Science	River Valley High School, Hwa Chong Institution

FOREWORD



Professor Ho Teck Hua

Chairperson, A*STAR Talent Search 2020 Awards Committee
Senior Deputy President and Provost,
National University of Singapore

The A*STAR Talent Search (ATS) has just completed its 15th year and continues to draw keen interest from the student community, with over 500 registered participants this year. This competition aims to inspire and encourage talented Singaporean students who have the passion and aptitude for scientific research. It provides them with opportunities to further their studies and acquire invaluable knowledge and guidance from veteran scientists and researchers.

This year, the Committee and I were impressed by the originality and quality of the research presented despite the evolving COVID-19 pandemic. The projects clearly demonstrated the creativity, potential, and even mastery possessed by our next generation of budding scientists and researchers. The journey towards scientific inquiry and discovery can be long and arduous. However, it is by overcoming challenges that we gain purpose and valuable experience. It is our hope that ATS continues to inspire and nurture our young talent to develop their research abilities in the pursuit of scientific excellence.

I wish to extend my congratulations to all those who participated in ATS 2020 for having engaged so strongly with their research topics.

To the seven finalists, you have come far and have much to be proud of, in terms of your research and communication skills. We hope that all of you will view the time spent in the competition as rewarding, especially during these unprecedented times.

We are honoured to have had the distinguished Nobel Laureate Professor Sir Konstantin S. Novoselov as the Chief Judge for final judging this year. I would like to thank him for offering his valuable time to engage with our young scientists and researchers. I would like to express my earnest appreciation to the organisers, the Agency for Science, Technology and Research, the Science Centre Singapore, the ATS Awards Committee and to all those who have contributed to the success of ATS.

My heartfelt thanks also go to the judges, mentors, principals and teachers who have devoted so much of their time and effort to work with the students and make this event a success. This year has been challenging for all of us, so I am heartened that the competition was not only able to proceed, but that the students showed such interesting and promising work. May we all remain strong, resilient and united during this challenging period.

Thank you.

Professor Ho Teck Hua

Chairperson, A*STAR Talent Search 2020 Awards Committee
Senior Deputy President and Provost,
National University of Singapore

QIU XINZHI

Synopsis of Project:

Advanced diagnostic techniques, such as PCR and ELISA, are widely used in well-equipped laboratories. However, they are expensive and inaccessible in resource-limited settings. With growing evidence that point-of-care testing (POCT) improves clinical outcomes, there exists a need for simple and rapid POCT techniques that can be rapidly developed. We thus present a one-pot universal detection platform, the DNA split proximity circuit (SPC), a rapidly developable point-of-care toolkit. Using a pair of "plug-and-play" DNA initiators, SPC is readily adaptable to various biomarkers ranging from nucleic acids to protein complexes, triggering a signal amplification readout based on Hybridization Chain Reaction (HCR).

By refining HCR hairpin designs, we first improved the kinetics and the sensitivity of HCR by 1000-fold. Using biomarkers related to breast cancer as model systems, we then applied the optimized HCR to our SPC system and demonstrated its capability to detect microRNA (miRNA) and cell surface receptors. SPC demonstrated good limit of detection in the femtomolar range within 30 minutes for all miRNA targets tested and robustness in challenging biological matrices such as cell lysate and serum. It also showed high specificity and an ability to discriminate against single-nucleotide polymorphisms and differentiate between different cell surface protein markers. Being isothermal and enzyme-free, our system is less sensitive to temperature and buffer conditions, thus showing great potential for bedside use.

With applications in multi-omic biomarker analysis, cell visualization and disease diagnostics, herein we improved and established the potential of SPC as a powerful next-generation POCT assay.

1ST PRIZE

- ▶ **School:**
NUS HIGH SCHOOL OF MATHEMATICS AND SCIENCE
- ▶ **Mentors:**
Dr Ang Yan Shan & A/P Lanry Yung Lin Yue
NUS Department of Chemical and Biomolecular Engineering
- ▶ **Project Title:**
DNA Proximity Circuit - A Universal Platform for Analyzing Biomarkers
- ▶ **Category Name:**
Biomedical Engineering

ATS FINALISTS 2020



JONATHAN CHEW JIAN PIN

Synopsis of Project:

The purpose of this project is to investigate the feasibility of utilising falling rainwater in Singapore's high-rise residential flats to generate electricity. A rainwater energy system was researched, designed, prototyped, and tested to determine the feasibility of rainwater as a source of renewable energy. The prototype is a scaled-down version of the actual rainwater energy system. Initial experiments were carried out in a horizontal flume pipe for constant flow.

Water was channelled via a funnel to create a laminar flow, which in turn drives a turbine which rotates a 9-volt DC motor serving as a generator. The experiment explored different types of turbines, water impact positions and gear ratios under a constant flow rate of 0.1709 litres/s. The most efficient setup from the experiment is a 10 cm diameter Pelton wheel with 20 equally spaced blades, with water jet hitting near the edge of the turbine, at a gear ratio of 0.1. After the initial testing, the final prototype was tested under a vertical pipe at different flow rates. The prototype produced a power of 1.1741 Watts at 78.1% efficiency at its peak.

- ▶ **School:**
RIVER VALLEY HIGH SCHOOL
- ▶ **Mentors:**
Dr Paul Ong Pang Awn
(Department of Civil and Environmental Engineering,
National University of Singapore)
- ▶ **Project Title:**
Conversion of Rainwater to Electricity in Singapore's High Rise Buildings
- ▶ **Category Name:**
Energy (Physical)



TIAN SHUHAO

Synopsis of Project:

We present a novel explicit series solution to large classes of homogeneous linear ordinary and partial differential equations. Our approach relies on constructing a solution series to the desired differential equation in terms of solutions to classes of simpler differential equations.

We derive the solution series using the homotopy analysis method, briefly discuss the mechanics and limitations of the solution series, such as issues of uniqueness and convergence, and illustrate the method by applying it to representative problems from various fields, like the Airy and Black Scholes equations. Finally, we touch on possible extensions and generalizations of our method.

- ▶ **School:**
HWA CHONG INSTITUTION
- ▶ **Mentors:**
Dr Wee Juan Dee
(Mathematics Department,
Hwa Chong Institution)
Professor Lim Kian Guan
(OUB Chair Professor of Finance,
Singapore Management University)
- ▶ **Project Title:**
An Explicit Series Solution for Large Classes of Linear Ordinary and Partial Differential Equations
- ▶ **Category Name:**
Mathematics



COMMENDATION PRIZE

- ▶ **School:**
HWA CHONG INSTITUTION
- ▶ **Mentors:**
Dr Chia Kok Pin
(Hwa Chong Institution)
Dr Rohit Medwal
(Nanyang Technological University,
Singapore)
- ▶ **Project Title:**
Hydrogen functionalization of graphene
using RF plasma for photodetection
- ▶ **Category Name:**
Materials Science

ETHAN JOHN LIM

Synopsis of Project:

The volume of data carried across the world by fibre-optic cables is surging, propelling an ever-increasing demand for faster communication systems. One of the main limitations of its speed is the rate at which the optical receiver can detect light. Graphene-silicon Schottky photodiodes are a promising alternative to traditional germanium photodiodes, promising higher detection frequency and better contrast between light and dark. To make it less susceptible to erroneous measurements caused by electrical noise, hydrogen functionalisation was used to increase its barrier potential so that a higher voltage would be required to allow current to pass through and trigger the sensor.

This study seeks to determine the optimal conditions — of physical proximity, duration of exposure, and plasma power — for hydrogen functionalisation using radio frequency plasma. Graphene was synthesised using chemical vapour deposition and then transferred onto P-type silicon to create a photodiode. To assess the effectiveness of hydrogen functionalisation, photocurrent measurements were conducted while light was shone onto the photodiode in pulses of increasing frequency to find the magnitude and spontaneity of the response. The sample demonstrated clear optoelectronic response and was sensitive to changes in frequency. Results show that the intensity of the optoelectronic response in graphene-silicon diodes is inversely related to its physical proximity to the plasma source during hydrogen functionalization; and directly related to the power of the plasma and to the duration of exposure up to a point, after which it will deteriorate. Thus, we can conclude that graphene-silicon Schottky diodes offer much promise in electronic communications.



COMMENDATION PRIZE

- ▶ **School:**
NUS HIGH SCHOOL OF MATHEMATICS
AND SCIENCE
- ▶ **Mentors:**
Dr Peter J. Bond, Dr Alexander Krahn,
Dr Jan Marzinek
Bioinformatics Institute, A*STAR
- ▶ **Project Title:**
Computational study of temperature
dependent protein glass transition
under varying solvent compositions
- ▶ **Category Name:**
Computational Biology and
Bioinformatics

MICHELLE YAOCHAI YINFEI

Synopsis of Project:

Proteins initiate their biochemical activity near their glass transition temperature. This dynamical transition into a glassy state confers flexibility to the protein sidechains, allowing them to undergo conformational changes that are critical to protein function. It is widely accepted that the protein glass transition temperature is influenced by the solvent compositions; in the absence of solvent, this transition of proteins cannot be observed.

Aligned with this theory, it has been shown experimentally that the presence of bioprotective compounds, such as sucrose and trehalose, increase the protein transition temperature. The molecular reasons underlying these altered transition temperatures are not understood. Here, molecular dynamics (MD) simulations were used to study lysozyme in three different chemical environments: solely water, sucrose/water and trehalose/water. Simulating these three systems from the temperature range of 20 K to 300 K in 10 K increments, the experimental trend of the transition temperatures can be reproduced based on the hydrogen mean-squared deviation (MSD). In addition, the hydrogen MSD approach was used to derive corresponding transition temperatures of water and disaccharides. This study accounted for protein stability by introducing a longer equilibration time for lysozyme in sucrose/water and trehalose/water environments. Local molecular interactions such as the hydrogen bonding properties of protein with the respective solvent environments were also calculated. Furthermore, potential applications, such as in stabilizing organs, biological drugs or preserving foods, were proposed based on this *in silico* workflow to develop highly effective bioprotective compounds.



COMMENDATION PRIZE

- ▶ **School:**
RAFFLES GIRLS' SCHOOL
- ▶ **Mentors:**
Dr Tang Kok Zuea
(NUS Faculty of Engineering)
- ▶ **Project Title:**
Development of an Intelligent System for Monitoring Birds' Health in the new Mandai Bird Park
- ▶ **Category Name:**
Engineering Mechanics

SARAH WONG EE MIN

Synopsis of Project:

In the new Mandai Bird Park, due to the sheer number of birds, constantly monitoring the health of birds will be a big feat. Thus, an intelligent system is developed to monitor the health of several species of birds within a feeding cage using image processing and deep learning through software programmes such as LabView, Autodesk Fusion 360 and Arduino. The system compares the data collected with a set of pre-set values to determine if the bird is healthy.

More specifically, the weight, feeding times and physical appearance will be monitored and analysed, to deem if the bird is healthy or not. The bird will enter the cage due to the bird feed in place before the bird is identified. Its weight, feeding times and physical appearance will be recorded corresponding to the particular bird, where the software programme will detect any abnormal circumstances and conclude the bird is unhealthy. Then, the cage doors will shut and the bird will be examined by the veterinarian. This prototype includes both the hardware engineering and software programming so as to create a suitable cage and an intelligent system. The prototype will be implemented at the new Mandai Bird Park for preliminary testing.



COMMENDATION PRIZE

- ▶ **School:**
NATIONAL JUNIOR COLLEGE
- ▶ **Mentors:**
Ms Lee Shan Shan
(National Junior College)
Dr Wendy Lee and Dr Puan Kia Joo
(A*STAR Singapore Immunology Network)
- ▶ **Project Title:**
Genetic regulation of cancer candidate CD123
- ▶ **Category Name:**
Biomedical and Health Sciences

THANGARAJA KEERTHANA

Synopsis of Project:

Interleukin-3 (IL-3) is a pleiotropic cytokine that regulates the growth and differentiation of haematopoietic cells through the IL-3 receptor. Various studies have found an association between the increased levels of the α -chain of the IL-3 receptor (CD123) and cancer of haematopoietic cells, but the genetic regulation of CD123 has never been studied in detail. In a previous pilot cohort, genome-wide search for protein quantitative trait loci (pQTLs) using whole blood from healthy donors revealed an association between two single nucleotide polymorphisms (SNPs) within the CD123 loci and CD123 protein levels in specific immune subsets.

Here, an independent cohort was used to validate the genetic regulation of CD123. Significant correlations were found between both SNPs and CD123 protein levels in immune subsets such as non-classical monocytes and basophils. This suggests that the two SNPs can be established as genetic biomarkers associated with elevated expression levels of CD123 protein. Through the successful validation of the pQTLs, future studies can analyse the role of the SNPs in blood cancers and develop better therapeutic interventions for treating blood cancers.

ACKNOWLEDGEMENTS

We would like to thank the following organisations that have contributed their domain experts to serve as judges for the Singapore Science and Engineering Fair 2020 and the A*STAR Talent Search 2020.

Agency for Science, Technology and Research (A*STAR)
 ASD Information Technology Pte Ltd
 DSO National Laboratories
 Duke-NUS Medical School
 Experimental Drug Development Centre
 GAG Engineering Services Pte Ltd
 JTC Corporation
 MDIS
 Ministry of Education
 Ministry of Home Affairs
 Nachusa Grasslands Nature Preserves, Franklin Grove, IL, USA
 Nanyang Polytechnic
 Nanyang Technological University
 National Environment Agency
 National Neuroscience Institute
 National Parks Board
 National Skin Centre
 National University Hospital
 National University of Singapore
 Newcastle University, Singapore
 Ngee Ann Polytechnic
 Orison QEHS LLP
 Prime Management Services
 Printed Power Pte. Ltd.
 Punggol 21 CCMC
 Republic Polytechnic
 Science Centre Singapore
 Singapore Botanic Gardens
 Singapore General Hospital
 Singapore Institute of Technology
 Singapore Management University
 Singapore Polytechnic
 Singapore University of Social Sciences
 Singapore University of Technology and Design
 SMRT Corporation
 Temasek Polytechnic
 University of Glasgow Singapore
 University of Newcastle, Australia (Singapore Campus)
 Yale-NUS College

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 Mr Redza Adly Esmadi SCS
 Mr Wong Yih Check MOE
 Ms Yang Yarong MOE
 Ms Gerlynn Yap MOE
 Mr Ho Kian Tong MOE

ATS/SSEF 2020 PARTICIPANTS

Tan Xin Yi

ANDERSON SERANGOON JUNIOR COLLEGE

Testing the effects of the exposure to magnetic fields for zebrafish

Sean Rui Ting, Ong Min Jee, Sim Hui Wen Adeline

ANDERSON SERANGOON JUNIOR COLLEGE

Investigate the efficacy of natural disinfectants against common bacteria

Chia Wang Hong, Edison Tan Say Kit,

Mohamed Rafsun S/O Abdul Azees

ANDERSON SERANGOON JUNIOR COLLEGE

Using Bacteria to control cockroach population in households

Chan Hao Jun, Nevin Hansel Simon

ANDERSON SERANGOON JUNIOR COLLEGE

Investigating the effectiveness of biodegradation of different sizes of plastic by mealworms

Edmund Siah Jun Hao, Wong Soong Ming, Axel Tan Ray Meng

ANDERSON SERANGOON JUNIOR COLLEGE

Building a Model to Provide Optimal Travel Routes for Commuters in Singapore

Wu Mengyuan, Cedric Phang Chun Zhong

ANDERSON SERANGOON JUNIOR COLLEGE

Compare Stock Investment Strategies Involving Financial Indicators

Tan Yung Zhen, Justin Neo Boon Shuan, Ong Chee How

ANDERSON SERANGOON JUNIOR COLLEGE

Artistic Transformation of In2O3 Nanowires via Focused Laser Painting

Cheong Ngai Hang, Ryan

ANDERSON SERANGOON JUNIOR COLLEGE

Finding Carpark level using OCR and Face Recognition

Chua Ming Wun, Joven, Matthew Loh

ANGLO-CHINESE JUNIOR COLLEGE

Effect of a high-fat diet on larval zebrafish behaviour

Xiao Liyang, Lim Yong Quan, Lim Guan Quan, Charles

ANGLO-CHINESE JUNIOR COLLEGE

Computational Analysis of Cancer RNAseq Data for Presence of Circular RNA to Assist Early Detection of Multiple Myeloma

Zheng Shun Ren, Tong Yi Xuan, Simon, Chan Yong Kai

ANGLO-CHINESE JUNIOR COLLEGE

Impedance Analysis of Perovskite Solar Cells

Henry Lam Wing Ha

ANGLO-CHINESE JUNIOR COLLEGE

Design for Antenna Gain Enhancement using Low Cost Dielectric Lens for applications in 5G technology

Charlotte Jane Loy, Kenneth Au Jeng Guan

ANGLO-CHINESE JUNIOR COLLEGE, NANYANG JUNIOR COLLEGE

Precision Polymer Synthesis and Nanotechnology

Jarryl Ng

ANGLO-CHINESE JUNIOR COLLEGE

Plasma Assisted Low Temperature Graphene Synthesis

Su Xijia

ANGLO-CHINESE JUNIOR COLLEGE

Solving Scarcity of Healthcare Resources with Big Data

Liu Hanrui

ANGLO-CHINESE JUNIOR COLLEGE

Growth of Social Networks with Opinion Tolerance Constraint: A Numerical Simulation Study

Richard Lim Feng Mian

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Effect of reagent concentration on the yield of cinnamyl alcohol from an YADH-catalysed reduction of cinnamaldehyde

Jeong Min Lee

ANGLO-CHINESE SCHOOL (INDEPENDENT)

The Strength of Homemade Chemical Peels

Kow Zhen Ting

ANGLO-CHINESE SCHOOL (INDEPENDENT)

The ability of L-Menthol as a chiral reagent to separate a racemic mixture of +/- Mandelic acid by means of kinetic resolution and measured through the rate of esterification between the L Menthol and each of the optically pure forms of Mandelic Acid, thr

Charlene Kok Hui Ping

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Development of small-molecule inhibitors of a protein-protein interaction by in silico fragment screening for development of cancer therapeutics

Tan Wei Ren Irving

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Virtual & Augmented Reality Technology Enhanced Army Logistic Training

Zhu Yaning

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Interfacial Engineering for High Efficient Perovskite Solar Cells

Matthew Tham Yong'An

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Synergistic effect of plant-derived cysteine proteases with conventional antibiotics on antimicrobial and antibiofilm activity against B. subtilis biofilms

Shaun Kwek Yi Le

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Effect of extruding temperature on the flexural properties of 3D printed Polylactic Acid (PLA)

Mark Theng Kaijun

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Morphological Engineering for Strain Sensor Design

Nallasami Tharun Balaji

ANGLO-CHINESE SCHOOL (INDEPENDENT)

How does the angle of separation between acoustic foam wedges affect the reflected sound intensity from the acoustic foam wedge plane? B. subtilis biofilms

Balaji Adithya

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Investigation of the Talbot effect for two-dimensional gratings

River Koh Ern Xin

ANGLO-CHINESE SCHOOL (INDEPENDENT)

Comparative Study of Long-Short Term Memory and Gated Recurrent Unit Neural Networks for Natural Language Processing

Jordan Sun Jing Tai, Hong Seokjun

ANGLO-CHINESE SCHOOL (INDEPENDENT), NANYANG JUNIOR COLLEGE
Inflammation in Human Coronary Artery Endothelial Cells by Trimethylamine N-oxide and Its Effects on Cell Proliferation and Nuclear Translocation of Nuclear Factor Kappa-light-chain-enhancer of Activated B Cell

Sharmain Lim Chen Ting, Lau Sook Yeang,**Mary Anne, Hoo Rae En**

CHIJ ST. NICHOLAS GIRLS' SCHOOL

Determining the suitability of food wastes in producing bioplastics in conjunction with starch

Natasya Nurfatihah Binte Ahmad Rahim

CLEMENTI TOWN SECONDARY SCHOOL

Restoring DNA Repair in cells over expressing histone H1

Hu Man Mak, Mubina Shahnaz, Jazreel Yu Jia En

CRESCENT GIRLS' SCHOOL

Deoxyribonucleic Acid Cloning

Kong Li Xuan, Victor Ng Yi Kun, Wilson Lim Yuxiang

DUNMAN HIGH SCHOOL

Effectiveness of Antimicrobial Infused-Alginate Based Packaging on Fruit Preservation

Wee Zhuo Lin, Huang Shi Rui, Darius Lim Xiang Wen

DUNMAN HIGH SCHOOL

Optimisation of bigel system to maximize delivery of plant derived anti-inflammatory compounds

Foo Xiu Kyi, Ter Wan Wenn Avriel, Valerie Lim

DUNMAN HIGH SCHOOL

*Comparison and Evaluation of Commercial Sunscreens and Various Plant Extracts used in UV Protection***Kathleen Yip Si Hui**

DUNMAN HIGH SCHOOL

*Investigating the Impact of Cigarette Filters on the Environment***Lin Shuowang**

DUNMAN HIGH SCHOOL

*Removal of Emerging Organic Contaminant by Low-cost Adsorbent***Choo Yan Ying Desiree, Pan Yifan**

DUNMAN HIGH SCHOOL

*Investigation of Flow Resistance and Air-Blast Propagation through Ventilation Pathways***Shua Yu Le, Irving, Shermain Koo Shi Xuan**

DUNMAN HIGH SCHOOL

*MediAid: Medicine Consumption Aid for the Visually Disabled***Koh Pi Rong, Wong Zhixuan, Gerlyn**

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*Green and Biodegradable Lignin Microbeads***Hu Tongyu, Shua Yee En, Cheryl**

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